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BOVINE MASTITIS

the most costly problem of the dairy industry

U. S. DEPARTMENT OF AGRICULTURE
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PREFACE

Information on bovine mastitis in the United States is available from many sources. This is an attempt to assemble and summarize this information (1) for review by animal health and dairy industry leaders and (2) to bring to the attention of farmers that a maximum allowable level for somatic cells (leucocytes) in milk shipped under the United States Public Health Service Recommended Milk Ordinance has been established to go into effect by July 1, 1970. The PHS recommended Milk Ordinance is the basic standard used in the Cooperative State PHS Program for Certification of Interstate Milk Shippers and some 120 million people live in jurisdictions utilizing its provisions.

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BOVINE MASTITIS

The Most Costly Problem of the Dairy Industry

THE PROBLEM

Bovine mastitis—a disease characterized by inflammation of the udder—has long been recognized as a serious problem of the dairy industry. All told, it cuts the Nation's total annual milk production by an estimated 10 percent, necessitates large expenditures for the treatment of infectious mastitis, causes loss of dairy cows from death and premature culling, and results in lower feed conversion rates and higher unit-labor costs for milk products than would prevail in mastitis-free herds.

Despite the fact that mastitis is the most costly disease plaguing the U.S. dairy industry, progress toward control has lagged for a number of reasons. Important among these reasons are that:

- Mastitis may result from any of a number of different microbial infections. Also a variety of contributory factors, such as physical damage to the udders or teats, faulty milking practices or equipment, and environmental stress, may help trigger the condition.
- The many forms and causes of mastitis complicate the task of preventing and treating the condition. For example, preventive measures and treatments effective against one form of infectious mastitis may not be effective against another form. Adverse environmental conditions, poor milking practices, or defective equipment may negate the beneficial effects of treatment to a large degree.
- In most dairying areas, laboratory services have been neither generally available nor adequate to handle the workload of effective mastitis control.
- Chronic mastitis is insidious in its effect, easily overlooked, and likely to spread and cause heavy losses before it is finally detected and brought under control.
- Although good milking procedures and equipment are important for safeguarding cows against injury, stress, and exposure to disease-causing organisms during milking, there is a shortage of well-trained milkers and equipment servicemen for installing, servicing, and maintaining milking machines. Also, in some areas, facilities do not exist for obtaining adequate information on the selection of milking equipment adapted to dairy operations of different sizes and types and on the maintenance and use of milking machines. Dairymen too may not realize the need for assistance in marginal situations.
- There are still many unanswered questions about mastitis and some conflicting evidence about the significance of various adverse environmental factors that may—either singly or in combination—help trigger infection of the cow's mammary glands and teats with mastitis-causing pathogens.

Despite present gaps in our knowledge, enough is now known to help dairymen prevent new cases of both infectious and noninfectious mastitis. Dairymen should follow good management and sanitary procedures and avoid purchase of infected animals. Losses in affected herds can be reduced by preventing the spread of infection through sanitation and by promptly detecting, diagnosing, and treating infected animals and segregating them for "end-of-the-string" milking. Although isolation may be idealistically desirable, it is not practiced routinely, nor will it be a required procedure in a proposed mastitis abatement program. Segregation for "end-of-the-string" milking would be urged. Constant vigilance, backed up by regular screening tests and periodic veterinary examinations of the herd, is important in fighting mastitis.

Need for a coordinated drive on a nationwide scale to combat mastitis, long urged by leaders of the dairy industry and of veterinary-medical and public health groups, has been intensified by recent trends and developments, such as the following:

- As competition becomes greater in the dairy industry, producers are finding it increasingly difficult or impossible to absorb the average 10-percent loss in production sustained by affected herds and the accompanying increase in unit production costs. Consequently, more and more dairymen are faced with the alternative of coping with the mastitis problem more effectively or going out of business.

- The continuing trend is to raise the quality standards for milk and other food products to keep pace with new research findings in agricultural production, marketing, nutrition, and public health. The emphasis on milk quality and wholesomeness is particularly strong because of its use in feeding infants, the sick, and the elderly. This concern is reflected in the high standards written into the "Grade 'A' Pasteurized Milk Ordiannce—1965 Recommendations of the United States Public Health Service." As of January 1968, about 120 million people in this country were living in jurisdictions utilizing the provisions of Public Health Service's recommended Milk Ordinance. The PHS recommended ordinance is also the basic standard used in the Cooperative State-PHS Program for Certification of Interstate Milk Shippers.

In line with this trend to raise food quality standards as scientific and technological progress permits, the National Conference on Interstate MIlk Shipments (NCIMS) in April 1967 adopted the last two phases of a three-phase program for the control of abnormal milk

The Abnormal Milk Program launched by NCIMS provides that laboratory examinations or screening procedures for determining the presence of unwholesome, altered mammary secretions whether from infectious, traumatic, or physiologic origin in raw milk for pasteurization shall be made at the same frequency as specified for bacteriological tests in milk sanitation standards of the PHS recommended. (*See* Appendix, page 9 for pertinent excerpts from the PHS recommended Milk Ordinance.)

Screening tests are used for locating abnormal milk under the NCIMS program. These are tests for estimating the leucocyte (Somatic cell) content of bulk samples of milk and are based on the reaction of milk samples to a reagent. Direct microscopic cell counts may also be conducted.

Because test results reflect the presence of epithelial and other body cells, as well as leucocytes, these screening tests are frequently referred to as approximations of the somatic cell content of milk.

The leucocyte, or somatic cell, counts in milk are not a specific check for mastitis. However, large numbers of body-defending white cells or leucocytes tend to rally in trouble areas of an animal's body to combat disease or traumatic conditions. Mastitis is a major cause of an adnormally high number of leucocytes in milk—and the mastitis screening tests are generally recognized as useful tools for pinpointing herds in which mastitis exists.

Phase III of the Abnormal Milk Program provides that effective July 1, 1970, any bulk milk showing a leucocyte count of 1.5 million or more per ml. (milliliter) in three out of five consecutive officially approved tests required in the Program will be the basis for possible sanctions and penalties. Under the Phase III provisions, milk suppliers who do not meet requirements for normal milk "shall have their permit suspended and/or court action shall be taken in accordance with Sections 3 and/or 6 of the 'Grade "A" Pasteurized Milk Ordinance—1965 Recommendations of the U.S. Public Health Service.' "

Phases I and II of the Program (now in effect) are designed to set up a system of PHS-approved screening tests in PHS-certified State laboratories to detect abnormal milk. This will help to determine whether or not dairy farmers producing milk for interstate shipment are meeting the prescribed standards and to point up the need for correcting adverse sanitary and management conditions conducive to the development of mastitis. (*See* pages 6-7 for details of the Abnormal Milk Program.)

Reflecting the increased need and demand for more concerted and effective action against mastitis, the National Association of State Departments of Agriculture (NASDA) at its convention in November 1966 resolved that the United States Department of Agriculture be requested to push ahead with studies of mastitis programs in the several States, contact research workers, develop control programs for mastitis on an area basis, evaluate these programs, and then develop a proposal for a national program.

At its meeting in October 1967, the U.S. Livestock Sanitary Association (USLSA)[1] —a group composed largely of representatives of the livestock industry and of State and Federal veterinary regulatory and public health officials—adopted its Mastitis Committee Report supporting the prior action taken by NASDA in encouraging Federal, State, and other regulatory agencies to develop and improve mastitis control programs. The Committee recommended that the USLSA urge Federal and State regulatory officials to institute appropriate measures to control and eradicate *Streptococcus agalactiae.* The Committee also recommended that the USLSA support the objectives of the milk quality control program of the NCIMS.

Need for an industrywide mastitis control program and fundamental principles for developing a desirable one were reported at the annual meeting of the National Mastitis Council (NMC) in Chicago in February 1968 by its Programs and Procedures Committee.

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[1] As of October 1968, officially changed to United States Animal Health Association (USAHA).

The Committee report, which was accepted by the NMC Board of Directors, recommends an industrywide mastitis control program to involve all dairy herds whether producing Grade "A" or manufacturing milk.

The Committee also recommended that an approved screening test be applied to bulk milk from all herds and that a herd mastitis control program be initiated whenever findings of consecutive screening tests for estimating cell concentration in milk point to unsatisfactory conditions.

The plating of all bulk samples on a selective medium for detection of *Streptococcus agalactiae* was also recommended on the premise that the particular type of infectious mastitis caused by *Str. agalactiae* can be eradicated if individual infected animals are detected and properly treated.

Among other recommendations of the report were the following: Education should precede action to assure cooperation of the entire dairy industry. The program should be organized on a Statewide basis and should be administered by someone with regulatory experience authority, or both, such as the State veterinarian. Pending establishment of a national mastitis effort, the U.S. Department of Agriculture is encouraged to make its animal health field staff available as far as possible in support of State mastitis control programs. State and local Departments of Public Health and the U.S. Public Health Service should be responsible for certification of laboratory services. Milk quality and animal health–the major aspects of a mastitis control effort–should both be served in the basic laboratory program. The results of all tests should be reported to all persons concerned. Practicing veterinarians should treat or supervise treatment of individual animals and furnish all other services they are qualified and willing to provide.

THE DISEASE

Bovine mastitis is a disease characterized by inflammation of the mammary glands. It gets its name from *mastos,* the Greek word for breast, and *itis,* a word-ending that means inflammation.

Most cases of bovine mastitis result from infection by microorganisms that invade the udder through the teats. However, the udder may also become infected by bacteria already in the animal's system.

Physical injury to the udder can also cause inflammation and infection may follow, resulting in persistent mastitis.

Rather than referring to a single disease, therefore, mastitis is a general term for an inflammation of the udder resulting from any of a number of different stresses and microorganisms that may cause changes in the udder which are characteristic of the malady.

The microorganisms that cause infectious mastitis are frequently spread at milking time by milking equipment used on susceptible animals following use on infected cows, or by the hands of milkers. The microorganisms can also be spread from calves drinking unpasteurized milk to the udders of calves that are sucked by them Bedding contaminated by secretions from the udders of mastitic cows or by any microorganisms capable of causing mastitis may also be a source of infection.

Udders or teats that have been injured by physical blows, cuts, or trampling, or damaged by faulty or improperly used milking machines are susceptible to infection. By lowering the cow's resistance, stress from crowding, poor housing (in hot, unventilated, or cold drafty quarters), and transporting the cattle probably increases the chances of clinical mastitis occuring with infected udders.

Currently, many authorities think that a combination of unfavorable factors rather than a single contributory condition may be required to trigger the development of infectious mastitis in a cow.

Some cows are probably more susceptible to mastitis than others because of the shape of their udders or other inherited characteristics. For example, long pendulous udders are more vulnerable to physical injury and associated infections, including mastitis, than are compact udders. Variations in breeds are not considered significant in the mastitis picture.

Symptoms and Diagnosis

A large proportion of the cases of bovine mastitis in the United States are in a subclinical stage. In its chronic subclinical stages, mastitis is difficult to recognize because there is little or no swelling of the gland and the abnormality in the milk is not sufficient to be recognized without special tests. This complicates the task of detecting mastitis promptly so that action can be taken to prevent its spread through a herd.

In acute clinical mastitis, the infected quarters are swollen, sensitive, hot, and hard. The milk is abnormal in appearance (containing flakes, clots, and sometimes blood), watery, and reduced in quantity. In some acute cases, the animal reacts with fever, rapid pulse, weakness, and loss of appetite.

In milder clinical cases, the milk may be abnormal in appearance and reduced in quantity although the udder appears normal or nearly so.

Acute cases of mastitis caused by physical injury usually recover spontaneously or yield to prompt and adequate treatment provided infection does not ensue.

Udder infections that have become established are more difficult to treat effectively. If the disease has progressed far enough, irreversible changes may have taken place in the mammary gland with the result that the milk secretion in one or more quarters is permanently reduced or stopped.

Accurate laboratory identification of the type of organism causing infectious mastitis is essential since the treatment that should be followed varies with the different types of infective organisms.

Microorganisms Associated with Mastitis

Although many different microorganisms have been implicated as causing bovine mastitis, about 90 percent of the cases result from infection by species of *Streptococcus* and *Staphylococcus* groups of bacteria, such as *Streptococcus agalactiae, Str. dysgalactiae, Str. uberis,* and *Staphylococcus aureus.* A small percentage of cases are caused by rod-shaped (bacillary) bacteria including *Escherichia coli, Aerobacter aerogenes, Pseudomonas aeruginosa, Corynebacterium pyogenes,* and a variety of other bacterial organisms including the Brucella and Mycobacterium groups. Occasional severe outbreaks of mastitis have been caused by the funguslike bacteria, *Nocardia asteroides,* by fungi including the pathogenic yeasts, by algae (Prototheca species), and by smaller microorganisms including the Mycoplasma and probably some viruses.

Some species of pathogens cause more serious mastitis than do others. Particular strains within a species are more virulent than others.

The many different pathogens that may cause mastitis complicate the job of preventing and treating the disease. Fortunately, the pathogen present in a given case can usually be identified in the laboratory. This enables the veterinarian to prescribe the medication appropriate to the particular type of infection involved.

Treatment

Mastitis caused by *Streptococcus agalactiae* responds to treatment with penicillin since these particular microorganisms are highly sensitive to this antibiotic. The outlook is hopeful for eradicating this form of mastitis if an approved program of testing, treatment, and sanitation (including segregation for "end-of-the-string" milking of infected cows) is put into effect on a nationwide scale.

Other common forms of mastitis, such as that caused by *Staphylococcus aureus,* are more resistant to treatment. Resistance of *Staphylococcus* spp. to antibiotics explains some cases for which medication is ineffective.

Suitable drugs can be administered by or under supervision of the veterinarian following diagnosis. However, if antibiotics have been injected before the veterinarian arrives, he will be handicapped in handling the case because the use of an antibiotic may prevent him from determining the specific microorganism involved.

If the mastitis is severe, gangrene may result; and, it may be necessary to surgically remove a teat to help drain off the toxins and save the life of the cow.

In addition to medication, good nursing is important in treating severe mastitis. For example, frequent hand milking of the affected quarter is helpful.

Milk from cows that have been treated with penicillin or other antibiotics or chemicals should be handled in separate containers and withheld from the market in accordance with instructions issued with the various medications and the provisions of the PHS recommended Grade "A" Pasteurized Milk Ordinance prohibiting the sale of adulterated milk.

TESTING FOR MASTITIS

Because mastitis is so frequently a "hidden" disease (without readily observable symptoms), a number of tests have been developed for detecting mastitis and determining causative microorganisms. These tests are of three general types:

(1) Screening tests that help disclose changes in the udder or milk composition caused by mastitis without requiring extensive laboratory facilities,

(2) Direct microscopic or electronic leucocyte (somatic cell) counts, and

(3) Bacteriological procedures designed to detect or confirm the presence of specific causative organisms and to determine their sensitivity to various medications.

Screening tests of several types are used on both individual cows and bulk milk.

Among the more widely used screening tests are the California Mastitis Test (CMT), the Modified Whiteside Test (MWT), the Wisconsin Mastitis Test (WMT), the Catalase Test, and the Direct Microscopic Somatic Cell Count (DMSCC). The first four of these tests estimate the number of leucocytes in milk samples through the use of a test reagent. The DMSCC determines the leucocyte content in a given quantity of milk by a systematic count of cells in milk samples applied in a thin film on a glass slide and stained so that the cells will be visible under a microscope.

These tests and variations of them used in various States and localities differ in materials, equipment, and procedures used—and the findings of some of them may be affected by a number of factors including the subjective judgment of the tester.

Although the tests based on leucocyte content are not specific for mastitis, the presence of excessively large numbers of leucocytes in milk from individual cows or in composite samples from herds suggests the presence of inflammation or infection. A high cell count does not necessarily indicate the presence of infectious mastitis. Many other factors may result in a relatively high cell count. The count tends to be higher during early and late stages of lactation, for example. The strippings are higher in cells than is the fore milk. The time of day the milk sample is collected causes variation, the count tending to be higher for several hours after milking. Also, the cell count rises gradually with the age of the cow. There is a vital need for standardizing test procedures to minimize the introduction of these and other variables that could affect the test findings.

Although a high leucocyte count points to the probability of mastitis in a herd, the presence of subclinical mastitis can be positively determined only by examination of individual cows by a veterinarian and by specific laboratory tests to confirm the presence of mastitis-causing organisms.

The multiplicity of screening tests and readings indicating a range of somatic cells require that the DMSCC or ESCC be used for confirmation and interpretation of the findings. This complicates the task of establishing and enforcing a maximum somatic cell count for interstate milk shipment. Failure to work out a more dependable common denominator for measuring the somatic cell content in rating milk as abnormal presents an obstacle to milk producers and shippers in the marketing of milk between different jurisdictions.

The accuracy of the screening tests has been questioned by some of the national milk producer's associations.

Standardization of testing procedures is being accomplished through the laboratory certification program of the U.S. Public Health Service.

PREVENTION BEST APPROACH TO MASTITIS CONTROL

The ancient proverb that an ounce of prevention is worth a pound of cure is applicable with extra force to a disease like mastitis, because no specific cure has been developed for most of the infectious forms. Alleviation is the best that can be hoped for in treating many cases of chronic mastitis even when full use is made of the present knowledge of the disease and its control.

Another urgent reason for concerted action to avoid mastitis is that antibiotics used in treatment not only result in contamination of the milk with residues which make it ineligible for sale, but the continued use of drugs may contribute to drug-resistant microorganisms, and sometimes cause injury to the cows. Studies have also shown that a high leucocyte level reduces the quantity of cheese that can be produced from a given quantity of milk even when there is no readily detectable effect on the quality of the cheese.

Prevention isn't simple or—in some instances—certain even when recommended precautions are carefully followed. Unfortunately mastitis appears occasionally in herds of dairy farmers who are striving to follow all the preventive management and sanitation practices recommended by animal health authorities. Such occurrences are discouraging to dairymen.

These occasional failures in the best defenses now available to prevent the disease cannot be entirely avoided in the present state of our knowledge. Nevertheless, animal health authorities agree that mastitis is less frequent and not so severe in herds that follow the commonly recommended practices for preventing and controlling mastitis.

Following are some types of preventive action recommended by the National Mastitis Council and other interested groups:

- Provide a favorable environment to avoid stress and injury—adequate housing with ample space; protection from temperature extremes and draft; protection against teat cuts and trampling.
- Follow sanitary practices such as sanitizing the milking machine cluster with circulating boiling water before each milking period and dipping teats in an effective disinfectant solution after milking, milking infected cows last,

disinfecting the milker's hands between each milking, never milking on floor, and keeping the floor covered with clean bedding.

- Inspect cattle daily for signs of mastitis and apply screening tests regularly to aid in early detection of the disease.
- Segregate infected cows from well animals and withhold their milk from the market.
- Raise replacements from the herd where possible. When buying replacements, take care not to "buy" infection—obtain cattle from herds known to be free of mastitis or have the animals examined for udder health by a veterinarian.
- Minimize the stress of the milking operation by following recommended milking practices and by using adequate milking machine equipment that is properly installed and maintained.

The farmer's need for getting and following expert advice on the care and use of a milking machine is emphasized by authorities in the veterinary profession and in the equipment manufacturing and dairy industries.

Among points emphasized by the Milking Machine Manufacturer's Council of the Farm and Industrial Institute as important to protect the cow from injury or undue stress are: Make the milking process quick by properly preparing the cows; attach teat cups within 1 minute following stimulation or as soon as the teats are full of milk; when milk flow is reduced to a minimum (after 2 to 3½ minutes in most cows), machine strip quickly or immediately remove the teat cups.

Danger of over-milking—letting the teat cups remain on the cow after milking is completed—is generally stressed. Because of this hazard, use of machine stripping is declining.

ABNORMAL MILK PROGRAM AND PROPOSED MASTITIS ABATEMENT PROGRAM—SEPARATE BUT MUTUALLY SUPPORTIVE

The Abnormal Milk Program adopted by the National Conference on Interstate Milk Shipments with the advice and concurrence of the U.S. Public Health Service and the mastitis abatement program proposed by animal health authorities have separate approaches and goals. However, they are mutually supportive and have the common objectives of assuring an abundance of wholesome milk from healthy cows to consumers and increased income for dairymen.

Both the Abnormal Milk Program and the proposed national mastitis abatement program would be cooperative State-Federal efforts. Each would provide standards and procedures to be met and followed by participating dairy farmers, one to avoid the marketing of abnormal milk and the other for preventing or alleviating mastitis or both.

Phases I and II of the three-phase Abnormal Milk Program are in effect. Phase III is scheduled to go into effect on July 1, 1970.

A proposed Cooperative State-Federal Mastitis Abatement Program to combat mastitis through an animal health approach is in the planning stage. However, State or area programs are in operation in many specific locations and experience gained in them will be valuable for formulating and implementing a possible nationwide mastitis abatement effort. A number of States and milksheds have already made encouraging progress in reducing mastitis problems through organized mastitis abatement programs which have overcome obstacles similar to those facing the dairy industry in other parts of the country.

Milk-producing farms in the milkshed serving Spokane, Wash., successfully reduced the leucocyte count of their milk to an acceptable level after health officials sponsored a program to raise milk standards and worked in an advisory capacity with producers.

Wisconsin, the Nation's leading dairy State in total milk production, has a mastitis control program for implementing effective abatement measures. Under the program now operating in Wisconsin, farms with mastitis problems are located by means of mastitis indicator tests. When mastitis is confirmed, effective abatement measures are recommended. Milk from herds that do not meet minimum standards set by the State of Wisconsin in its mastitis control program is withheld from the market until the disease condition has been satisfactorily abated.

Ontario, Canada, also has a mastitis program underway. Canadian animal disease control officials report that the program has been highly successful to date in reducing infection in herds of cooperating farmers.

In Ontario, screening tests and an inspection and advisory program are sponsored by the provincial government and paid for, in part, by participating dairymen. A dramatic drop in the leucocyte count of milk shipped by manufacturing-milk producers (as distinct from producers of fluid milk) was reported following schools in which the producers attended classes where intensive instruction on mastitis prevention measures was given.

THE ABNORMAL MILK PROGRAM

Noting that the dairy industry and the milk regulatory authority are jointly responsible and should use all available resources and techniques to eliminate abnormal milk from the milk supply, the National Conference on Interstate Milk Shipments (NCIMS) at its April 1967 meeting adopted the last two phases of a three-phase abnormal milk program to go into effect in July 1968 and July 1970, respectively.

The use of indicator tests for estimating the numbers of leucocytes in milk was recommended as "an adjunct to already existing tests to provide the consumer with a safe, high quality product consistent with the production of wholesome dairy products."

Need for uniform screening tests for estimating the leucocyte content of milk is emphasized in the program recommendations, which cite a published statement of the National Mastitis Council, Inc., that says:

"Presence of more than 500,000 leucocytes per ml. of mixed herd milk strongly suggests a significant incident of mastitis in a given herd."

Originally a maximum allowable leucocyte count of 1,000,000 leucocytes per ml. was suggested for the Abnormal Milk Program, but to allow more latitude to dairy farmers beginning a new program, 1,500,000 was finally set as the immediate standard.

The 1967 NCIMS resolution endorsing an Abnormal Milk Program says:

"The Committee recognizes that current knowledge cannot be expected either to eradicate or completely control bovine mastitis, but is of the opinion that the standard of not more than 1,500,000 leucocytes per ml. on herd milk is attainable by known control procedures which will effectively exclude from supplies that milk produced under conditions which disregard mastitis prevention and control procedures."

A side benefit expected from implementation of an Abnormal Milk Program would be progress toward greater uniformity between local health and sanitary authorities in the various States and cities regarding milk quality standards.

Phase I of the Abnormal Milk Program has been in effect since July 1, 1967. It provides that laboratory examinations or screening procedures for the presence of unwholesome, altered mammary secretions whether of an inflammatory, infectious, physiological, or environmental origin, in raw milk for pasteurization, shall be made at the same frequency as specified for bacteriological tests in the milk sanitation standards specified in the USPHS recommended Standard Milk Ordinance. The screening tests for abnormal milk are based on somatic cell counts—both estimated and direct. (*See* section on "Testing for Mastitis," for information on screening tests.)

The Abnormal Milk Program specifies that official indicator tests "shall be conducted by an approved laboratory utilizing the official indicating tests for the detection of abnormal milk published by the U.S. Public Health Service and subjected to the State Laboratory Certification Program."

Phase I of the Program further specifies that the milk producer shall be notified of all test results.

Phase II, in effect since July 1, 1968, provides that "only those interstate milk shippers that are certified to be following an indicating test program shall be listed in the quarterly publication, 'Sanitary Compliance and Enforcement Ratings of Interstate Milk Shippers.' " These listings are consulted by States and municipalities in considering for approval potential sources of wholesome milk to supply their needs.

Phase II also provides that, when a herd milk sample tested by an approved laboratory indicates the presence of 1,500,000 or more somatic cells per ml., a warning letter will be sent to the producer. After a second consecutive test indicating a somatic cell count of 1,500,000 or more per ml., the dairy will be inspected by an official sanitarian or person designated by him. Following a third sample (out of five) indicating a somatic cell count in excess of 1,500,000 per ml., the milk regulatory authority shall, if he deems it necessary, require the producer to: (1) Have milking equipment analyzed by a milking equipment serviceman. (2) Have individual animals examined by a veterinarian. (3) Require cows producing abnormal milk be milked separately and milk withheld from the milk supply.

Phase III of the recommended program provides that a penalty clause shall be added effective July 1, 1970, for noncompliance with somatic cell standards. Under the plan, milk suppliers having 1,500,000 somatic cells or more per ml. in three out of the five last tests and continued violation of specific standards of sanitation (as set forth in "Grade 'A' Pasteurized Milk Ordinance—1965 Recommendations of the U.S. Public Health Service") shall have their permit suspended or court action shall be taken in accordance with Sections 3 and 6 of the Ordinance. However, the plan provides that the 1,500,000 per ml. somatic cell count will not be officially recorded or a penalty applied unless it is corroborated by direct microscopic leucocyte count or the equivalent conducted in accordance with standards published by the U.S. Public Health Service and subject to the State Laboratory Certification Program.

MASTITIS ABATEMENT

Need for a nationwide effort to abate mastitis has been urged by leaders of the dairy industry and veterinary-regulatory officials in many parts of the country.

Proponents of such a coordinated nationwide drive to combat mastitis emphasize that much can be done to alleviate the problem, while acknowledging the difficulties involved. However, they point out that the success of abatement efforts would require full cooperation of the entire dairy industry and of agricultural leaders on a nationwide scale. At present, the degree of participation within the individual States in formal, coordinated mastitis abatement efforts varies widely.

Such a program, if adopted, would recognize the need to improve animal health but, at the same time, be designed to help the dairymen meet the public health requirements for unadulterated milk. Its primary objectives, reflecting the needs of farmers and for scientifically tested know-how for fighting the disease, would be to:

(1) Assure that all dairymen will be able to comply with the minimum standards of the Interstate Milk Shippers Certification Program and the PHS recommended ordinance,

(2) Provide or make available all necessary services to effectively deal with the mastitis problem,

(3) Eradicate that form of mastitis caused by the bacterium–*Streptococcus agalactiae,* and

(4) Assure that all dairy cows in channels of trade are healthy in all respects, including freedom from udder disease.

Among the reasons advanced by agricultural and animal health leaders why an organized nationwide program to combat bovine mastitis should be launched are the following:

- Dairy farmers cannot indefinitely afford the economic losses resulting from mastitis.
- A successful mastitis program would help dairy farmers become more efficient by:

(1) Increasing the average milk yield per cow,

(2) Reducing the appearance and spread of infectious mastitis in previously uninfected herds,

(3) Reducing losses of cows through death or premature culling,

(4) Reducing costs for mastitis medication and treatment,

(5) Eliminating losses from milk withheld from market as a result of mastitis (either because of a high somatic cell count associated with the disease or contamination with penicillin or other drugs used in treating mastitis), and

(6) Increasing feed conversion efficiency.

- Whereas milk standards are high in comparison with other foods, the quality of milk must continue to improve to keep pace with the current trend toward higher food standards. The need for assuring high-quality milk is intensified because of its importance in the diets of infants, invalids, and old people and because the place of milk in the food market has been difficult to maintain in recent years.

Some Obstacles to be Overcome

A number of obstacles would need to be overcome in implementing a national Cooperative State-Federal Mastitis Abatement Program. These include:

- A shortage of dairy herd practice veterinarians.
- A shortage in many areas of experts needed to advise farmers on the care and use of milking machines.
- A shortage of trained milkers.
- Large herds and a shortage of labor which puts a premium on haste while milking. This too frequently results in the adoption of assembly line methods in which all cows are treated alike despite a wide variation in their milking characteristics. It also aggravates the tendency to skip daily examination of cows and their milk. These daily checks are important to avoid overlooking overt symptoms of mastitis or injuries likely to result in infectious mastitis.

Requirements for a Program to Combat Mastitis

A national Cooperative State-Federal Program to combat mastitis–in common with already established and successfully operating programs to control other animal diseases–would require for its implementation that certain tools and procedures be agreed upon by participating States and jurisdictions.

Among the requirements recognized as necessary for implementing a national disease control program are:

- Adoption of a few reliable, inexpensive, and easily administered tests for indicating or confirming the presence of mastitis or conditions leading to mastitis in a herd. They should be acceptable to participating States and jurisdictions. This includes standardization of procedures for administering and interpreting the tests and a system whereby ratings under one system can be measured in terms of others, particularly those used in other jurisdictions. This is now being done through the State Laboratory Certification Program of the United States Public Health Service.

- Expanded bacteriological-culturing capability for identifying infected animals and determining the nature of the infection. Facilities and personnel now available for such diagnostic service are insufficient to meet the needs of a national mastitis control program.
- An expanded education program to (1) alert dairy-farm owners and workers to the need for combating mastitis and (2) provide guidelines for effectively using the best available scientific and technological know-how for preventing and alleviating the disease. This is being done through the Cooperative Extension Service and many local institutions and organizations.

Suggested channels for reaching dairymen with the required information include:

- Schools for milkers which would (1) train dairy workers on proper procedures for milking as well as adequate maintenance and operation of milking machines to avoid udder tissue injury which could lead to persistent mastitis; (2) teach farmers to be discriminating in selecting dairy equipment suited to their needs.
- Inspection of dairy farms producing milk with a high somatic cell count to discover contributory conditions and provide guidance in overcoming them.
- A frequent check by qualified personnel of milking equipment for functional defects.
- Assurance that adequate veterinary service will be available to help farmers with their mastitis problems by:
  (a) examination of animals as needed and
  (b) prompt diagnosis and treatment of diseased animals.
- Enlisting aid of and assisting farm organizations, extension agents, vocational agriculture teachers, agricultural colleges, dairy product processing plants, milking machine distributors, and veterinary organizations to emphasize the need for concerted action by the dairy industry to fight mastitis.

APPENDIX

Text of Recommended Abnormal Milk Program

Because of its importance as an incentive for raising the quality of milk produced and the support it gives to the implementation and enforcement of the proposed national program to combat mastitis, the text of the Abnormal Milk Program as approved at the April 1967 meeting and amended at the May 1969 meeting of the National Conference on Interstate Milk Shipments is presented below.

Text of
ABNORMAL MILK PROGRAM
as approved by the April 6, 1967, meeting of
THE NATIONAL CONFERENCE ON INTERSTATE MILK SHIPMENTS
and amended at the May 29, 1969, meeting

Approved at April 1967 Conference:

All segments of the dairy industry should adopt and support a uniform program for the control of abnormal milk. The dairy industry and the milk regulatory authority are jointly responsible and should use all available resources and techniques to eliminate abnormal milk from their milk supply.

Indicator tests for the detection of excessive numbers of leucocytes in milk are recommended as an adjunct to already existing tests to provide the consumer with a safe, high quality product consistent with the production of wholesome dairy products. Uniform screening programs for the detection of leucocytes are needed.

The "Grade 'A' Pasteurized Milk Ordinance—1965 Recommendations of the United States Public Health Service" emphasizes the use of screening tests to determine the presence of abnormal milk in Section 7, item 1r.

"Current Concepts of Bovine Mastitis," published by National Mastitis Council, Inc., states on page 18 that "presence of more than 500,000 leucocytes per ml. of mixed herd milk strongly suggests a significant incidence of mastitis in a given herd." Colostrum milk, mastitis, udder injury, stripper milk, and diseased cows are some of the common causes of high leucocyte counts. The committee recognizes that current knowledge cannot be expected to either eradicate or completely control bovine mastitis, but is of the opinion that the standard of not more than 1,500,000 leucocytes per ml. on herd milk is attainable by the application of known control procedures which will effectively exclude from supplies that milk produced under conditions which disregard prevention and control procedures.

Although several areas have operational programs, a comprehensive program for the control of abnormal milk will be new in many areas. People must be trained to properly fulfill their roles and budgets must be adjusted. For this reason, the committee feels that a program for the control of abnormal milk should be implemented by successive steps.

PHASE I–Effective July 1, 1967

The agreements of the National Conference on Interstate Milk Shipments state in Section II.A.5. that "Effective July 1, 1967, laboratory examinations or screening procedures for the presence of unwholesome, altered mammary secretions, whether of an inflammatory, infectious, physiological or environmental origin, in raw milk for pasteurization, shall be made at the same frequency as specified for bacteriological tests in the milk sanitation standard specified in Section I.A.2."[2] The milk producer shall be notified of all test results.[3] The official indicator test shall be conducted by an approved laboratory utilizing the official indicating tests for the detection of abnormal milk published by the USPHS and subjected to the State Laboratory Certification Program.

PHASE II–Effective July 1, 1968

After July 1, 1968, only those interstate milk shippers that are certified to be following an indicating test program shall be listed in the quarterly publication, "Sanitary Compliance and Enforcement Ratings of Interstate Milk Shippers."

It is recommended that the U.S. Public Health Service adopt official laboratory indicating test(s) for the detection of abnormal milk and that such test(s) be published by the U.S. Public Health Service and subjected to the State Laboratory Certification Program.

After this date, when a herd milk sample tested by an approved laboratory indicates the presence of 1,500,000 or more leucocytes per ml., the following procedure shall be followed:

a. A warning letter shall be sent to the producer notifying him of the high leucocyte count. The letter shall also list the principal causes of excess leucocyte counts.

b. Following the second consecutive test indicating a raw milk count of 1,500,000 or more leucocytes per ml., an inspection shall be made by an official sanitarian or a person designated by him.[4]

c. A third milk sample shall be taken. If this sample also indicates a leucocyte count of 1,500,000 or more per ml., the milk regulatory authority shall, if he deems it necessary, require the producer to:

1. Have milking equipment analyzed by a milking equipment serviceman.
2. Have individual animals examined by a veterinarian.
3. Have cows producing abnormal milk milked separately and withhold their milk from the milk supply.

PHASE III–Effective July 1, 1970

A penalty clause shall be added for noncompliance with leucocyte standards.[5] Milk supplies having 1,500,000 or more leucocytes per ml. on three out of five of the last tests and continued violations of applicable items of sanitation (1r and/or 14r) shall have their permit suspended and/or court action shall be taken in accordance with Section 3 and/or 6 of the "Grade 'A' Pasteurized Milk Ordinance–1965 Recommendations of the U.S. Public Health Service": provided that leucocyte counts of 1,500,000 or more per ml. shall not have been officially recorded nor penalty applied unless corroborated by the direct microscopic leucocyte count or the equivalent as published by the USPHS and subjected to the *State Laboratory Certification Program.*

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[2] Section I.A.2. of Procedures Governing the Cooperative State-Public Health Service Program for Certification of Interstate Milk Shippers.

[3] *Editor's Note:* This section–Phase I of the Abnormal Milk Program as approved by the National Conference on Interstate Milk Shipments–was updated at the May 1969 CIMS meeting in a report that noted, "The requirement that the milk producer has to be notified of all test results has been omitted in the USPHS Guidelines." (*See* section on "Adopted at May 1969 Conference" of this report.)

[4] This section of the NCIMS recommendations on Phase II of the Abnormal Milk Program was amended at the May 1969 meeting so that the requirement for "a farm inspection after the second high count" was changed to "a farm inspection after the second high count within any consecutive 6 months." (*See* IV Mastitic Milk, B, and Phase II, in section on "Adopted at May 1969 Conference" of this report.)

[5] This section of the NCIMS recommendations on Phase III of the Abnormal Milk Program was amended at their May 1969 Conference to spell out the proposed penalty for noncompliance. The USPHS Guidelines do not require punitive action at this time. The proposed revision is a recommendation of the Public Health Service on the additions needed to provide for suspension and reinstatement of permits. (*See* section on "Adopted at May 1969 Conference" of this report–IV Mastitis Milk and Phase III.)

The NCIMS chairman shall, with the advice and consent of the Executive Board, appoint an Adhoc Committee on Abnormal Milk Control whose responsibility it shall be to coordinate the efforts of this Conference with those of other official and unofficial groups developing methods and conducting studies on abnormal milk control, which Committee shall report to the 1969 NCIMS with recommendations for action at that time.

Adopted at May 1969 Conference:

The IMS Committee on Abnormal Milk Control held meetings in Chicago on February 14, 1968, and in St. Louis on August 19, 1968. In these meetings and in correspondence the Committee reviewed the status of the abnormal milk program with respect to the Conference action at Miami in April 1967. This included a comprehensive review of the Public Health Service "Guidelines for the Control of Abnormal Milk" published in May 1968. The views of official agencies, educational institutions, and industry were considered.

The Committee recommends that the National Conference on Interstate Milk Shipments adopt section IV of the Public Health Service Guidelines and recommends that the Public Health Service make certain revisions in paragraphs "B" and "C". The revised section IV would read as follows:

IV *Mastitic Milk*

"The health authority requires such additional tests for the detection of abnormal milk as he deems necessary." The tests include, but are not limited to, tests indicating udder inflammation–namely, excessive somatic cells. Tests for somatic cells are found in PHS publication No. 1306, *Screening Tests for the Detection of Abnormal Milk.* Four indirect tests are used for screening raw milk samples and the results indicate a range of somatic cell levels. These are the California Mastitis Test, The Catalase Test, the Modified Whiteside Test, and the Wisconsin Mastitis Test. The fifth test, the Direct Microscopic Leucocyte Count, measures somatic cells directly and current research indicates that this test should properly be called the Direct Microscopic Somatic Cell Count. (DMSCC) A more precise test than the DMSCC procedure that was developed after publication of PHS No. 1306. is the Electronic Method of counting somatic cells.

After July 1, 1967, required laboratory examination for the presence of unwholesome, altered mammary secretions–whether of an inflammatory, infectious, physiological, or environmental origin–shall be made on all raw milk samples at the same frequency as that specified for bacterial count samples in Section 6–The Examination of Milk and Milk Products, *Grade "A" Pasteurized Milk Ordinance.* Samples shall be analyzed at an official laboratory or an officially designated laboratory approved by the State milk laboratory certifying agency for the indirect or direct tests specified. Those tests listed in PHS publication No. 1306, *Screening Tests for the Detection of Abnormal Milk,* and the Electronic Method shall satisfy this requirement. For purposes of uniformity, a screening test that may be read objectively is highly desirable. The results of these tests shall be recorded by the regulatory agency on the official records for each dairy farm.

It is necessary that mastitis control programs be organized to assist the interested dairyman in controlling mastitis. This program should involve all resources which may be of assistance. The National Mastitis Council, Inc. has published a guideline for the establishment of such a control program which is available from the National Mastitis Council, Inc., 910 17th Street, NW, Washington, D.C. 20006.

After July 1, 1968, when a herd milk sample exceeds any of the following screening test results:

California Mastitis Test	Weak positive (CMT 1+)
Catalase Test	30% oxygen
Modified Whiteside Test	Positive (1+)
Wisconsin Mastitis Test	WMT value of 28

a confirmatory count, using the Direct Microscopic Somatic Cell Count or the Electronic Method shall be made on that sample and the result of this count shall be the official result.

Whenever the confirmatory count indicates the presence of greater than 1,500,000 somatic cells per ml., the following procedure shall be followed:

A. A notice shall be sent to the producer warning him of the excessive somatic cell count. The notice should also list the more likely causes of high somatic cell counts.

B. Following the second confirmatory count of greater than 1,500,000 somatic cells per ml. within any consecutive 6 months, an inspection shall be made by the regulatory agency or by certified personnel as specified in Section 5 of the *Grade "A" Pasteurized Milk Ordinance.* This inspection should be made at milking time to be most effective.

C. A third milk sample shall be taken after a lapse of three days and within 14 days of the inspection required under "B" above. If three of the last five samples indicate a count greater than 1,500,000 somatic cells per ml., the milk regulatory agency shall proceed with its responsibility to suspend the dairyman's permit for violation of item 1r or other applicable requirements of the *Grade "A" Pasteurized Milk Ordinance.*

Upon written application by the dairyman stating that the cause(s) for the abnormal milk has been corrected, within one week an inspection shall be made. If the results of the farm inspection indicate that there is no longer a violation of item 1r, a temporary permit shall be issued. Samples shall then be taken at the rate of not more than two per week on separate days within a three week period. The health authority shall reinstate the permit when the results of these samples indicate that there is no longer a violation of the standards for abnormal milk.

The above material is the recommended revision of section IV of the Public Health Service "Guidelines for the Control of Abnormal Milk." When the revised paragraphs "B" and "C" become effective, references to the dates July 1, 1967, and July 1, 1968, will no longer be significant and should be deleted.

Acceptance of the Public Health Service Guidelines as modified by the IMS Committee on Abnormal Milk Control will result in the following changes in the program approved by the IMS Conference at Miami in April 1967:

Phase I—No change except the requirement that the milk producer shall be notified of all test results has been omitted in the Guidelines.

Phase II—The farm inspection requirement after the second consecutive high count has been changed to a farm inspection after the second high count within any consecutive 6 months.

The PHS Guidelines require a confirmatory count in Phase II when the screening test indicates a count in excess of 1,500,000 cells per ml. The program approved at the Miami IMS Conference required the confirmatory count only in Phase III.

Specific requirements have been omitted with reference to the advice the milk producer is to obtain in the event of high counts. The Miami agreement calls for analysis by a milking equipment serviceman and herd examination by a veterinarian. The Guidelines call for the dairyman to obtain expert advice for the correction of his problem.

Phase III—The Guidelines do not require punitive action at this time. The proposed revision is a recommendation to the Public Health Service on the additions needed to provide for suspension and reinstatement of permits.

Excerpts From
"Grade 'A' Pasteurized Milk Ordinance"–
(1965 Recommendations of the United States Public Health Service, U.S. Pub. Health Serv. Pub. 229, Second Printing, 1967)

PART I

GRADE "A" PASTEURIZED MILK ORDINANCE–1965 RECOMMENDATIONS OF THE UNITED STATES PUBLIC HEALTH SERVICE. . . .

. . .SECTION 5. INSPECTION OF DAIRY FARMS AND MILK PLANTS

Each dairy farm, milk plant, receiving station, and transfer station whose milk or milk products are intended for consumption within ___ [1] or its police jurisdiction shall be inspected by the health authority prior to the issuance of a permit. Following the issuance of a permit, each dairy farm and transfer station shall be inspected at least once every 6 months and each milk plant and receiving station shall be inspected at least once every 3 months. . . . .

. . .SECTION 6. THE EXAMINATION OF MILK AND MILK PRODUCTS

During any consecutive 6 months, at least four samples of raw milk for pasteurization shall be taken from each producer and four samples of raw milk for pasteurization shall be taken from each milk plant after receipt of the milk by the milk plant and prior to pasteurization. In addition, during any consecutive 6 months, at least four samples of pasteurized milk and at least four samples of each milk product defined in this Ordinance shall be taken from every milk plant. . . . .

Required bacterial counts and cooling temperature checks shall be performed on raw milk for pasteurization. In addition, antibiotic tests on each producer's milk or on commingled raw milk shall be conducted at least four times during any consecutive 6 months. When commingled milk is tested, all producers shall be represented in the sample. All individual sources of milk shall be tested when test results on the commingled milk are positive. Required bacterial counts, coliform determinations, phosphatase, and cooling temperature checks shall be performed on pasteurized milk and milk products.

Whenever two of the last four consecutive bacteria counts, coliform determinations, or cooling temperatures, taken on separate days, exceed the limit of the standard for milk and/or milk product, the health authority shall send a written notice thereof to the person concerned. This notice shall be in effect so long as two of the last four consecutive samples exceed the limit of the standard. An additional sample shall be taken within 14 days of the sending of such notice, but not before the lapse of 3 days. Immediate suspension of permit in accordance with Section 3 and/or court action shall be instituted whenever the standard is violated by three of the last five bacteria counts, coliform determinations, or cooling temperatures. . . . .

Samples shall be analyzed at an office or appropriate officially designated laboratory. All sampling procedures and required laboratory examinations shall be in substantial compliance with the ___ Edition of Standard Methods for the Examination of Dairy Products of the Americal Public Health Association and the ___ Edition of Official Methods of Analyses of the Association of Official Analytical Chemists. (Insert edition number current at time of adoption.)

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[1] Substitute proper legal jurisdiction here and in all similar places throughout the Ordinance.

. . .SECTION 7. STANDARDS FOR MILK AND MILK PRODUCTS

. . .Sanitation Requirements for Grade A Raw Milk for Pasteurization

ITEM 1r. ABNORMAL MILK

Cows which show evidence of the secretion of abnormal milk in one or more quarters based upon bacteriological, chemical, or physical examination, shall be milked last or with separate equipment, and the milk shall be discarded. Cows treated with, or cows which have consumed chemical, medicinal, or radioactive agents which are capable of being secreted in the milk and which, in the judgment of the health authority, may be deleterious to human health, shall be milked last or with separate equipment, and the milk disposed of as the health authority may direct. . . . .

. . .ITEM 14r. MILKING–FLANKS, UDDERS, AND TEATS

Milking shall be done in the milking barn, stable, or parlor. The flanks, udders, bellies, and tails of all milking cows shall be free from visible dirt. All brushing shall be completed prior to milking. The udders and teats of all milking cows shall be cleaned and treated with a sanitizing solution just prior to the time of milking, and shall be relatively dry before milking. Wet hand milking is prohibited. . . . .

Following is a list of a few selected publications on various aspects of mastitis.

Publications

"Current Concepts of Bovine Mastitis." 1965. National Mastitis Council, Inc., 910 Seventeenth Street, N.W., Washington, D.C. 20006. $1.00.

"Milking Management and Its Relationship to Milk Quality." University of California, Agricultural Extension Service Pub. AXT-94, Revised, Davis, Calif. 95616. (n.d.)

"The Modern Way to Efficient Milking." The Milking Machine Manufacturers Council of the Farm and Industrial Institute, 410 N. Michigan Avenue, Chicago, Ill. 60611. $1.00. (n.d.)

"Screening Tests for the Detection of Abnormal Milk." U.S. Public Health Service Pub. 1306. 1965. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. 20 cents.

"Grade 'A' Pasteurized Milk Ordinance–1965 Recommendations of the U.S. Public Health Service." U.S. Public Health Service Pub. 229. 1967. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. $1.25.

SOME SOURCES OF INFORMATION AND PUBLICATIONS ON MASTITIS

Where to go for authoritative information on mastitis is a question facing farmers who wish to improve their individual mastitis prevention and control programs. Sources for obtaining such information are given below.

Agencies and Organizations

State health departments and city or county health officers having jurisdiction over milk quality and the U.S. Public Health Service which works in an advisory capacity in the establishment of milk standards.

State agricultural colleges and the Agricultural Extension Service, including the county agricultural agents engaged in dissemination of information about mastitis (for general information on mastitis and specific recommendations based on regional research, local conditions, and State regulations).

Milking machine manufacturers and their local sales and service representatives (regarding proper installation, use, and maintenance).

Milk processing plants and their buyers (regarding standards for milk used in processing and requirements for meeting these standards).

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Hyattsville, Maryland 20782

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